DOCUMENT RESUME

ED 090 271 TM 003 547

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TITLE Effects of Experimentally Induced Familiarization of Content and Different Response Modes on Achievement from Programmed Instruction.
SPONS AGENCY City Univ. of New York, N.Y.; Office of Education (DHEW), Washington, D.C.
PUB DATE [Apr 74]
GRANT OEG-2-B-012
NOTE 24p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, Illinois, April 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Achievement; Course Content; Graduate Students; Individual Differences; *Learning; Learning Experience; *Programed Instruction; *Response Mode; Retention; Sex Differences; Time Factors (Learning)
IDENTIFIERS Attribute Treatment Interaction

ABSTRACT

This study investigated attribute by treatment interactions between prior familiarity and response mode to programmed materials for college level subjects by manipulating subjects' familiarity. The programs were a revised version of Diagnosis of Myocardial Infraction in standard format and in a reading version. Materials to familiarize subjects with the technical vocabulary and electrocardiogram tracings were developed. The critical measures were the scores attained on the verbal and technical post-test and the delayed post-test. The data, analyzed using multiple linear regression, yielded significant response mode by familiarity interactions on three of the four criteria. Theoretical and practical implications are discussed. (Author)

ED 090271
TM 003 547

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Session #12.07

Effects of Experimentally Induced Familiarization of Content and Different Response Modes on Achievement from Programed Instruction

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The use of linear programmed instruction (PI) as a teaching tool is of general importance to education. One of the basic assumptions of PI is that, for maximum learning, it is essential for the student to construct his responses as he progresses through the instructional program. Earlier research dealing with the question of the effects on achievement from PI of varying the response mode have not confirmed the hypothesized difference (Anderson, 1967; Tobias, 1968). Achievement was comparable if the S constructed (overt), "thought" (covert), selected (multiple choice), or read his response.

In a more recent review of the response mode issue in PI (Tobias, 1973b), the general lack of achievement differences was confirmed. However, an earlier suggestion (Tobias, 1969, Tobias & Abramson, 1971) that there was an interaction between response mode and the Ss prior familiarity with the material to be learned was reiterated and expanded. It was hypothesized that overt responding would produce higher achievement if the material to be learned was new to the S and that there would be no difference in achievement between Ss exposed to different response modes for material with which the Ss were already familiar. A plausible explanation for the failure of many studies to find superiority for the constructed response mode was that Ss were already familiar with the material to be learned before beginning their instructional program. It appeared that when the response was already in S's

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repertory there was no benefit in constructing the response, but when the response was new to the S constructing the response improved performance.

In examining the PI literature, no study was found which started with unfamiliar material, induced a degree of familiarity in Ss prior to their exposure to the program, and then examined the effects on achievement resulting from different response modes. The present study deliberately manipulated Ss familiarity with the material in the attempt to establish the existence of such an "attribute treatment interaction" or ATI. Thus, the major purpose of this research was to produce familiarity x treatment interactions for achievement from programmed instruction under controlled conditions. Furthermore, this study examined the effects of these interactions on achievement as measured on an immediate and delayed post-test.

The general hypothesis of this study was that, for PI, an S's prior familiarity with the subject matter to be learned would interact significantly with the response mode required of S.

Specifically, for groups who were and were not familiarized with the subject matter:

1. Constructed (overt) responses were not expected to result in differences in achievement.
2. Silent reading (covert) responses were expected to lead to greater achievement by the familiarization group.
3. Achievement for the familiarized covert group was expected to equal that of the overt response group.

METHOD

This investigation used a factorial design, with familiarity and response mode as the two independent variables. The effects of these variables and the degree to which they interacted with sex was determined by

multiple linear regression techniques, as suggested by Cronbach and Snow (1969).

Subjects

A total of 60 Ss, 30 of whom were female, was recruited from graduate courses in educational research taught by the principal investigator at The City College of New York. Ss were asked to participate by the principal investigator and were told that the rationale, instrumentation, design, etc., of the study would be used as illustrative material during the course. Experience (Tobias & Abramson, 1970) had shown that college and graduate students who participate in research studies of this type do not necessarily do so with the purest of motives. The belief that Ss were deeply engaged in the experimental task and were really attempting to learn the material was found to be an over-optimistic assumption. It was felt that incorporation of the study into the instructional procedures of the course would lead to more highly motivated Ss. The Ss who volunteered, not all the enrolled students did, were paid six dollars for their participation and told that the experiment was designed to study the different ways people learn from programmed instruction.

Materials

The program used in this experiment consisted of a revised version of The Diagnosis of Myocardial Infraction (Mechner, undated), and had been revised and employed in a series of investigations at The City College of New York (Tobias, 1968, 1969a,b; Tobias and Abramson, 1970, 1971). Only the 89 frames consisting of technical verbal and technical pictorial (ECG tracings) content which Ss were unlikely to have been exposed to previously, were included in this study. A full description of the program, program scoring, post-test, post-test scoring, reliabilities, etc., has been given elsewhere (Tobias, 1968).

The program was presented in standard PI format, with the correct response to each frame given in the left margin of the following page. Ss were told to respond to each frame before turning the page to see the correct response. To insure that Ss could not see the answer through the page, a matter of some concern in earlier studies (Tobias and Abramson, 1970), the back of the left margin of each page was printed with random black "squiggles."

A separate reading version of the program which contained completed statements in each frame and did not require overt responses from the Ss was prepared for the reading condition.

Materials to familiarize the Ss with some of the technical vocabulary and ECG tracings were developed for this study (Abramson & Kagen, 1973). Ten technical terms and five tracings were selected from the program for this purpose and were given to the familiarization groups at the start of their first session.

Procedures

Two sessions were required to collect the data for this study. During the first session, Ss were given either the PI or reading version of the program which was immediately followed by a post-test. One week later the same post-test was readministered.

The Ss were randomly assigned to the familiarization (F) or the non-familiarization (NF) condition. Half of the F and NF Ss were randomly assigned to the constructed response (CR) and half to the reading (R) condition. Thus there were 15 Ss under each of the following conditions: familiarization - consturcted response (FCR), familiarization - reading (FR), non-familiarization - constructed response (NFCR), non-familiarization - reading (NFR). One female in the FCR group was dropped because she did not return for the delayed post-test.

The Ss in the F condition were given the familiarization material before the program. They were given four minutes to copy a list of 10 vocabulary words twice and to memorize the list. No definition of the terms were given. They were chen given two minutes to reproduce the list from memory. The Ss were then asked to study and match two groups of five tracings and to draw a copy of each tracing. Two minutes were allowed for these tracing tasks. Following these tasks the program was administered.

The experiment was conducted with CR and R groups in separate rooms since the CR program generally takes longer than the R program and it was essential that the CR Ss not be disturbed by the Ss in the R condition completing their tasks and leaving earlier. As each S completed his program, his work time was recorded and the post-test was given to the S; when S finished his test the time was again recorded and S was dismissed. Approximately one week later Ss were given the same post-test with each individual's time recorded.

Results

The critical measures in this investigation were the scores attained on the post-test (PT) and the delayed post-test (DPT). The scores on the tracing and the verbal sections were considered separately, yielding a total of four criterion measures.

The data were analyzed using multiple linear regression techniques, as outlined by Kelly, et. al. (1969). A subject's group membership was represented as a 0 for the CR group and a 1 for the R group. Similarly, the F group was coded as a 0 and the NF group as a 1. Interaction vectors between the experimental variables were the simple products of the component vectors. A preliminary analysis (1 way ANOVA) indicated that there was differential sex effect ($F = 4.73$, $p < .05$) on the PT tracing data. Therefore, a binary sex vector was added to the analysis with males coded 0 and females coded 1. The full model[1] for the analysis of the achievement data thus included the three main variables of response mode, familiarization, and sex and the four interactions between them.

The analysis followed a stepdown procedure which started with the full model and tested for the significance of any variable or interaction of interest included in the full model. The test was conducted by forming a reduced model through the removal of the component of interest and then testing for the reduction in the resulting multiple correlation. This procedure allowed for the estimation of the percentage of variance contributed independently by any variable adjusted for the effects of all other variables.

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[1]Beta weights, regression coefficients, and other data pertaining to the full models can be found in Abramson & Kagen, 1973.

Table 1 indicates that none of the main effects were consistently sig-

Insert Table 1 about here

nificant. Sex had a differential effect in favor of the males only on the PT tracing score ($F = 5.54$). Response mode and familiarization showed differential effects on the DPT tracing score ($F = 4.87$; $F = 7.85$, respectively), with the CR and the F groups scoring highest. These differences for only some but not all, the criterion scores parallel the inconclusive findings of the earlier studies that prompted this investigation.

On the other hand, Table 1 clearly supports the main hypothesis of this study that response mode would interact with prior familiarity. On three of the four criterion measures (PT tracing, DPT tracing, DPT verbal) there was a significant response mode x familiarization interaction, and the interaction approached significance on the fourth criterion (PT verbal). On the PT and DPT verbal scores there was also a significant response mode x familiarization x sex interaction. Following the suggestions of Berlin and Cahen (1973) for ATI studies, the interaction data are presented in both tables and figures.

Table 2 shows the means and SDs for each group on the four criteria.

Insert Table 2 about here

There was a significant response mode x familiarization interaction on the PT tracing and the DPT tracing. Figure 1 is a representation of the interactions

Insert Figure 1 about here

resulting from the plotting of the means of the PT and DPT tracing scores. Clearly, familiarization affected the two response mode conditions differently. On the PT, prior familiarization resulted in a relatively high criterion mean for the Ss in the reading condition. For the CR group, familiarization led to a criterion mean a little lower than under the no familiarization condition. On the tracing retention measure, the DPT, prior familiarization had relatively as strong a beneficial effect on the R group as it had a detrimental effect on the CR group.

There were significant triple interactions on the PT and DPT verbal cri-

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Insert Table 3 about here

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terion. Table 3 shows the means and SDs for the groups according to sex, and Figures 2 and 3 are pictorial representations of these data. For both males

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Insert Figures 2 and 3 about here

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and females there was a response mode x familiarization interaction, but the interaction was different for each sex. The interaction for the males on the PT verbal criterion (see Fig. 2) was comparable to that generally found on the tracing data. Namely, familiarization led to increased achievement for the R group and to lower achievement for the CR group. There was an ordinal interaction for the females on the PT verbal score with the CR group higher than the R group under both F and NF conditions. On this criterion there was a significant increase in achievement under the F condition for the CR females.

The DPT verbal data diagrammed in Figure 3 exhibit an interaction comparable to that shown on the PT verbal scores, but the differential effects on the DPT of familiarization are more pronounced in the R group than on the PT

verbal scores. The male NFR group performed more poorly than any other group while the male FR group had the highest achievement. The female CR groups exhibit the same effects of familiarization as on the PT verbal score, but here the NFR group scored higher than the NFCR group, producing the typical disordinal interaction shown in the other data (see figures 1 and 2).

An ANOVA was performed on the amount of time spent on the program and on each of the criterion tests. These data are shown in Table 4. The analysis on program time showed an anticipated huge main effect for response mode

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Insert Table 4 about here

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(F = 333.17). Inspection of the data indicates that this was due to the relatively long time it takes to complete the CR program. The same analysis for the PT time showed another large effect for response mode (F = 49.00) with the CR group taking about half the time the R group spent on the test. This large effect disappeared on the DPT where there was virtually no difference between the groups.

Data for the percentage of correct responses to the program were available only for the two CR groups. These data, analyzed in the same manner as the achievement data, yielded no significant differences between the F and the NF groups for either the tracing or the verbal portions for the program. Both groups had 70-80% correct responses on the program.

The familiarization material for the two familiarization groups was also scored. Ss scored better than 80% correct, implying that Ss did attempt to learn the familiarization material.

Discussion

ATI

The results of this experiment clearly support the notion of an ATI between prior familiarity with material and response mode for achievement from programmed instruction. The finding that constructing response leads to superior achievement compared to achievement from a reading mode when the material is unfamiliar replicates previous findings (Tobias, 1969a, b: Tobias & Abramson, 1970), and provides strong experimental support for the position recently taken by Tobias (1973a) with regard to the familiarity interpretation. The hypothesized ATI was found for both verbal and tracing tasks but occured most clearly on the tracing material. As expected, familiarizing Ss with aspects of the tracing material prior to their exposure to the program led to superior achievement when the learning program followed a reading mode. However, the same familiarization led to lower achievement when the constructed response mode constituted the format of the program--an unexpected result as the hypothesis was for no difference between familiarized and unfamiliarized groups on the constructed response mode of the program.

The nature of the ATI was more complicated on the verbal material where there was a sex x familiarity x response mode triple interaction. Among males, the ATI had the same general form on the verbal material as the combined male and female group showed on the tracing material. That is, familiarization led to improved performance on the verbal material for the reading mode Ss and lower achievement for the constructed response Ss.

The females had an opposite ATI. Familiarization led to higher achievement from the constructed response mode and lower achievement for the reading mode. The comparatively high scores achieved by the females in the non-familiarized reading condition on the DPT (see Table 3) may have been due to the nature of the Ss in that group rather than the treatment since the expected drop in achievement on the delayed test, administered one week later, was exhibited by every group except the female non-familiar reading group.

Response Mode

It had been hypothesized that familiarization would not affect achievement from the constructed response mode groups. A possible explantion for the unexpected finding that familiarization led to lower achievement from a constructed response mode than did non-familiarization follows a motivation-attention argument. For the graduate students it became counterproductive to elicit an overt response to every frame after previously familiarizing Ss with the material to be learned from the program. These relatively superior learners might have become bored with the learning program when they were forced to respond to each frame whether or not they already knew the correct answer. This is particularly so in view of the inherent redundancy built into most linear programs. Thus, it was thought that the familiarized group was not as attentive as the non-familiarized group and thus did not learn as much.

Sex

The sex difference in the direction of the constructed response x familiarization ATI at the college level was somewhat puzzling but may be understood (or perhaps explained away) in terms of the familiarity hypothesis and Maccoby's (1972) male-impulsive and female-passive model of cognitive differences between the sexes.

The biographical questionnaires indicated that there were eight male

and nine female science majors in the sample. However, in general, females in our culture have less exposure to and interest in technical-scientific subject matter than do males. The type of subject matter of this experiment, myocarial infarction and its diagnosis (including analysis and reproduction of ECG tracings), was therefore probably more familiar, interesting, or challenging to the males. Thus, the males may have known some of the information, even if, not necessarily the exact responses required by the program. The pre-familiarization may have taught the females just enough to increase their knowledge to the level of the response repertoire of the non-familiarized males. The females being more passive than their male counterparts did not get "turned off" and continued to attend to the program until they completed their tasks, whereas the CR males might not have attended to the entire program. Thus, the constructed response pre-familiarized females, starting from the same knowledge level as the non-pre-familiarized males, achieved as well as the males who were given the constructed response program without pre-familiarization. Because the non-pre-familiarized females started at a knowledge level lower than thier male counterparts, they ended up at a lower achievement level.

Delayed Post-test

An interesting finding of this study was that the relative differences in the amount of learning as measured on the immediate post-test became more pronounced on the retention test. The interactions on immediate learning accounted for 7% and 5% of the variance while on the retention test, administered one week later, the interactions accounted for 21% and 12% of the variance. The sharpening of achievement differences on the retention test is consistent with Ausubel's theory of meaningful learning (Ausubel, 1968). Ausubel proposed one mechanism, assimilation, to account for both learning and forgetting and concluded that retention was a direct effect of initial

learning. He stated that the most important factor for learning and consequently for retention, is the prior presence of clear, stable, relevant ideas to act as "anchors" for the new material. Ausubel suggested that advance organizers should therefore be provided. The familiarizing material in this study may have acted as an organizer, providing the necessary anchors and allowing the material to be more completely incorporated into the learner's cognitive structure. The data from this study, showing that the differences in performance increased during the retention interval support this theoretical position. There was a differential rate of forgetting; Ss who learned more initially forgot at a slower rate than Ss who did not initially learn as much.

Time

In accord with the findings of other investigations, present results indicated that constructed response groups required significantly more time than the reading groups to cover the same material. A basic discussion of the efficiency issue has been given in an earlier study (Tobias & Abramson, 1970) and will not be repeated here. The important result, as pointed out above, was that the longer period of time and forced responding seemed to have adverse effects on achievement for Ss who were both good learners and familiar with the subject matter. The post-test time data support the "attention" interpretation of this finding. Ss who had the constructed response program, which required triple the time of the reading program, took about one-half the time to complete the post-test as compared to Ss who had the reading program. This test time difference did not result in differences in achievement since the high scoring constructed response group required the same amount of time as the low scoring group. Similarly, the reading groups required the same amount of time whether they scored high or low. It appears that Ss whose learning task took a long time (over an hour) raced through

their test in order to finish their assignment. When the delayed test was administered, all the groups took equal time, indicating that the differential effect on the post-test time was probably due to the program that was given immediately preceding the test.

Implications and Conclusion

Although the present results clearly support a familiarization x response mode interaction, the data do not permit a clear and consistent theoretical interpretation of these interactions. However, the results of the study have implications for instructional methodology. College level females who are to learn technical unfamiliar material similar to that employed in this study from PI should first be provided some familiarizing material and then given the complete program requiring constructed responses. On the other hand, the optimum strategy for college level males requires the instructor either to implement a constructed response program without prior familiarization or to provide familiarizing material followed by a reading program. The latter option would require less time and thus increase available instructional time. If the students are already familiar with the material then a reading program would be most beneficial. In any event, Bracht (1970) notwithstanding, this study provides data on the existence of ATI's, and their effects on achievement from programmed instruction.

References

Abramson, T., & Kagen, E. Effects on achievement from programmed instruction of experimentally induced familiarization of content and different response modes. Final Report, U.S. Office of Education Contract No. OEG-2-22B012. New York: City University of New York, 1973.

Anderson, R.C. Educational psychology. Annual Review of Psychology, 1967, 18, 103-164.

Ausubel, D.A. Educational psychology: A cognitive view. New York, N.Y.: Holt, Rhinehart and Winston, Inc., 1968.

Berliner, D.C. & Cahen, L.S. Trait-treatment interactions and learning. In Fred N. Kerlinger (Ed.), Review of Research in Education. Itascal, Ill.: Peacock Publishers Inc., 1973.

Bracht, G.H. Experimental factors related to aptitude treatment interactions. Review of Educational Research, 1970, 40, 627-645.

Cronbach, L.J., & Snow, R.E. Individual differences in learning ability as a function of instructional variables. Final Report, U.S. Office of Education Contract No. OEC 4-6-061269-1217. Stanford: Stanford University, 1969.

Kelley, F.J., Beggs, D.L., & McNeil, K.A. Multiple regression approach. Carbondale, Ill.: Southern Illinois University Press, 1969.

Maccoby, E. Sex differences in intellectual functioning. In J. Bardwick (Ed.), Readings on the Psychology of Women. New York: Harber & Row, Publishers, 1972.

Mechner, F. Diagnosis of myocardial infarction. Undated.

Tobias, S. The effect of creativity, response mode, and subject matter familiarity on achievement from programmed instruction. New York: MSS Educational Publishing Co., 1968.

Tobias, S. Distraction and programmed instruction. Technical Report No. 2, Programmed Instruction Research Project. New York: City College, City University of New York, 1969(a).

Tobias, S. The effect of creativity, response mode, and subject matter familiarity on achievement from programmed instruction. Journal of Educational Psychology, 1969, 60, 453-460(b).

Tobias, S. Sequence, familiarity, and attribute by treatment interactions in programmed instruction. Journal of Educational Psychology, 1973, 64, 133-141(a).

Tobias, S. Review of the response mode issue. Review of Educational Research, 1973, 43, 193-204(b).

Tobias, S., & Abramson, T. The relationship of anxiety, stress, response mode and content difficulty to achievement from programmed instruction. Technical Report No. 4, Programmed Instruction Research Project. New York: City College, City University of New York, 1970.

Tobias, S., & Abramson, T. Interaction among anxiety, stress, response mode, and familiarity of subject matter on achievement from programmed instruction. Journal of Educational Psychology, 1971, 62, 357-364.

Footnotes

1 This study was supported by a grant from the United States Office of Education, Project No. 2-b-012, and a grant from the City University of New York, Research Foundation Project No. 01687. A report on this project was read at the American Educational Research Association Annual Convention, Chicago, April 1974.

TABLE 1

Multiple Linear Regression Analysis of Achievement Data

		Posttest				Delayed Posttest			
		Tracing		Verbal		Tracing		Verbal	
Effect	df	% Var.	F	% Var.	F	% Var.	F	% Var.	F
Response Mode (A)	1		a	.02	1.51	.07	4.87*	.02	1.09
Familiariza-tion (B)	1	.04	2.63	.02	1.51	.11	7.85**		
Sex (C)	1	.09	5.54*	.04	2.55	.04	2.99[b]		
A X B	1	.07	4.52*	.05	3.06[b]	.21	14.76**	.12	7.85**
A X C	1			.10	6.22*			.06	3.67[b]
B X C	1			.07	4.31*	.02	1.65	.04	2.48
A X B X C	1			.09	5.31*			.14	9.23**

[a] F values less than 1 not shown

[b] $p < .10$

* $p < .05$

** $p < .01$

TABLE 2

Means and Standard Deviations on the Verbal and Tracing Posttest and Delayed Posttest

		Posttest				Delayed Posttest			
		Verbal		Tracing		Verbal		Tracing	
Group	N	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
FCR	14	30.43	7.59	22.29	8.43	25.50	5.60	14.11	7.33
NFCR	15	29.33	8.84	24.13	10.36	25.33	10.93	24.17	9.82
FR	15	28.00	8.64	27.40	6.99	26.20	9.10	22.00	10.91
NFR	15	26.60	8.10	20.13	10.24	22.13	8.90	12.70	11.18

TABLE 3

Means and Standard Deviations for the Males and Females on the Posttest and Delayed Posttest Verbal Scores

	Males					Females				
		Posttest		Delayed Posttest			Posttest		Delayed Posttest	
Group	N	$\bar{X}$	SD	$\bar{X}$	SD	N	$\bar{X}$	SD	$\bar{X}$	SD
FCR	7	27.00	8.52	24.14	6.87	7	33.86	4.98	26.86	4.06
NFCR	7	32.29	8.56	29.14	11.33	8	26.75	8.78	22.00	10.09
FR	7	32.29	4.07	31.14	6.07	8	24.25	10.04	21.88	9.39
NFR	8	27.13	8.81	18.63	9.69	7	26.00	7.85	26.14	6.31

TABLE 4

Mean Time in Minutes Spent by Ss in Completing the Program and Criteria Achievement Tests

	CR	R
Program Time	72.00	25.77
Post-test Time	13.07	22.76
Delayed Post-test Time	12.69	12.17

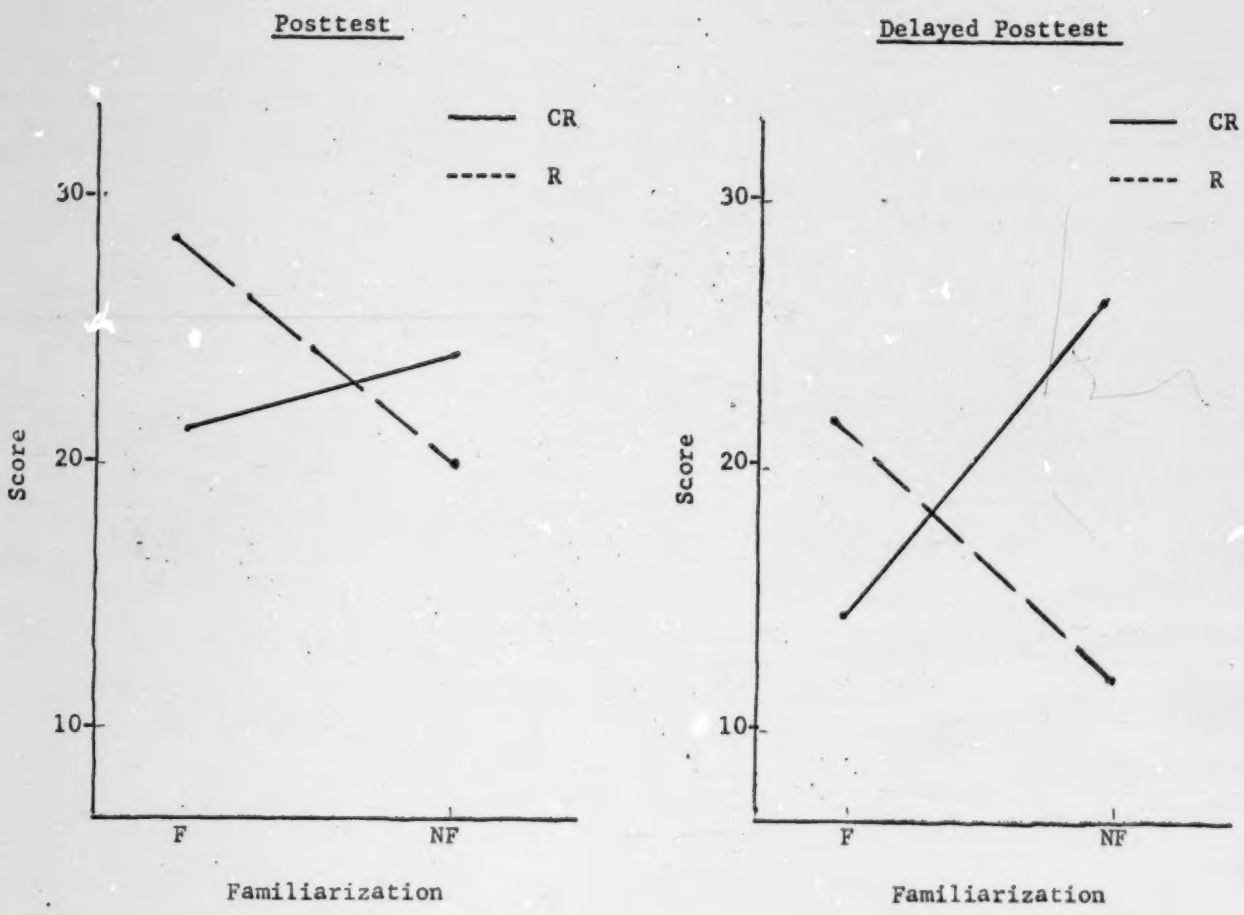

Fig. 1. Mean scores attained on the tracing portion of the posttest and the delayed posttest.

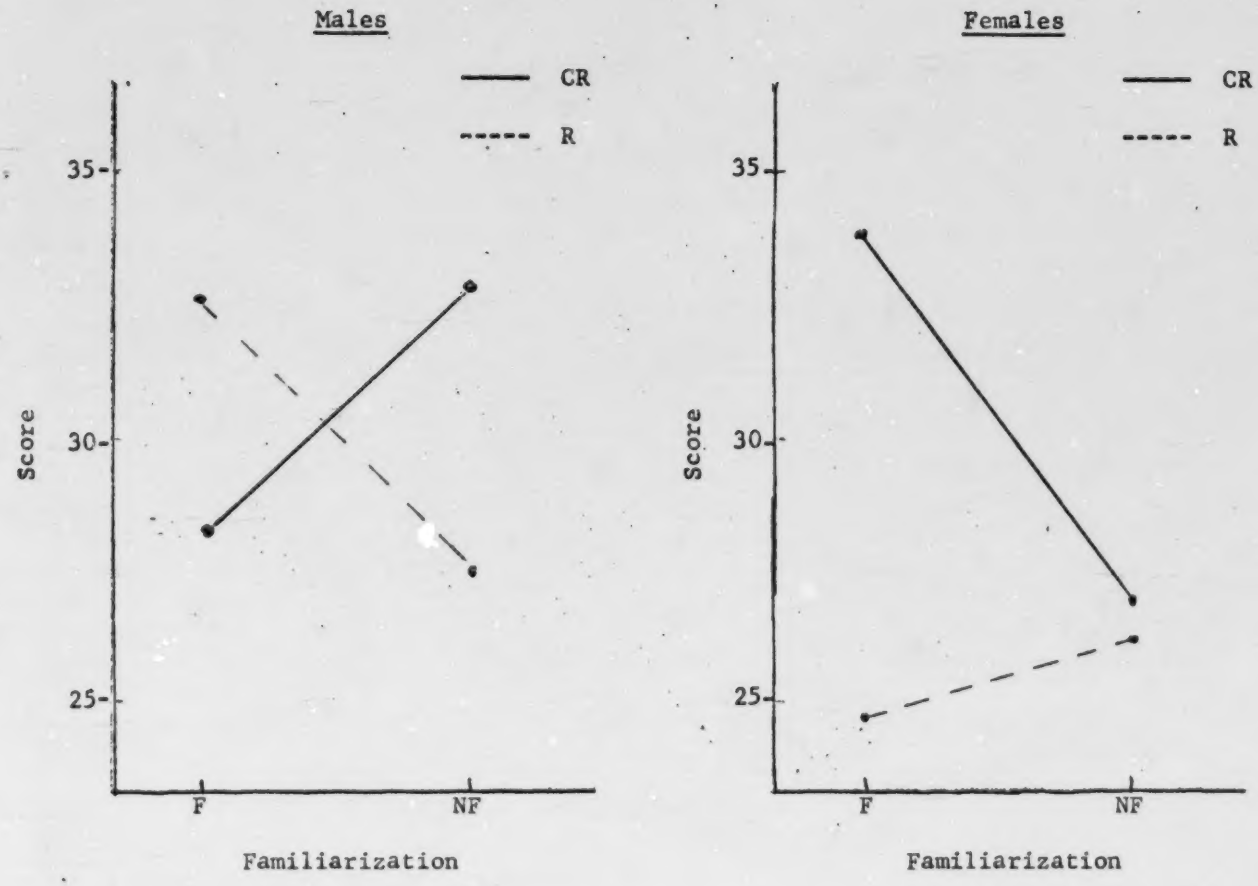

Fig. 2. Mean scores attained on the verbal portion of the posttest for male and female Ss.

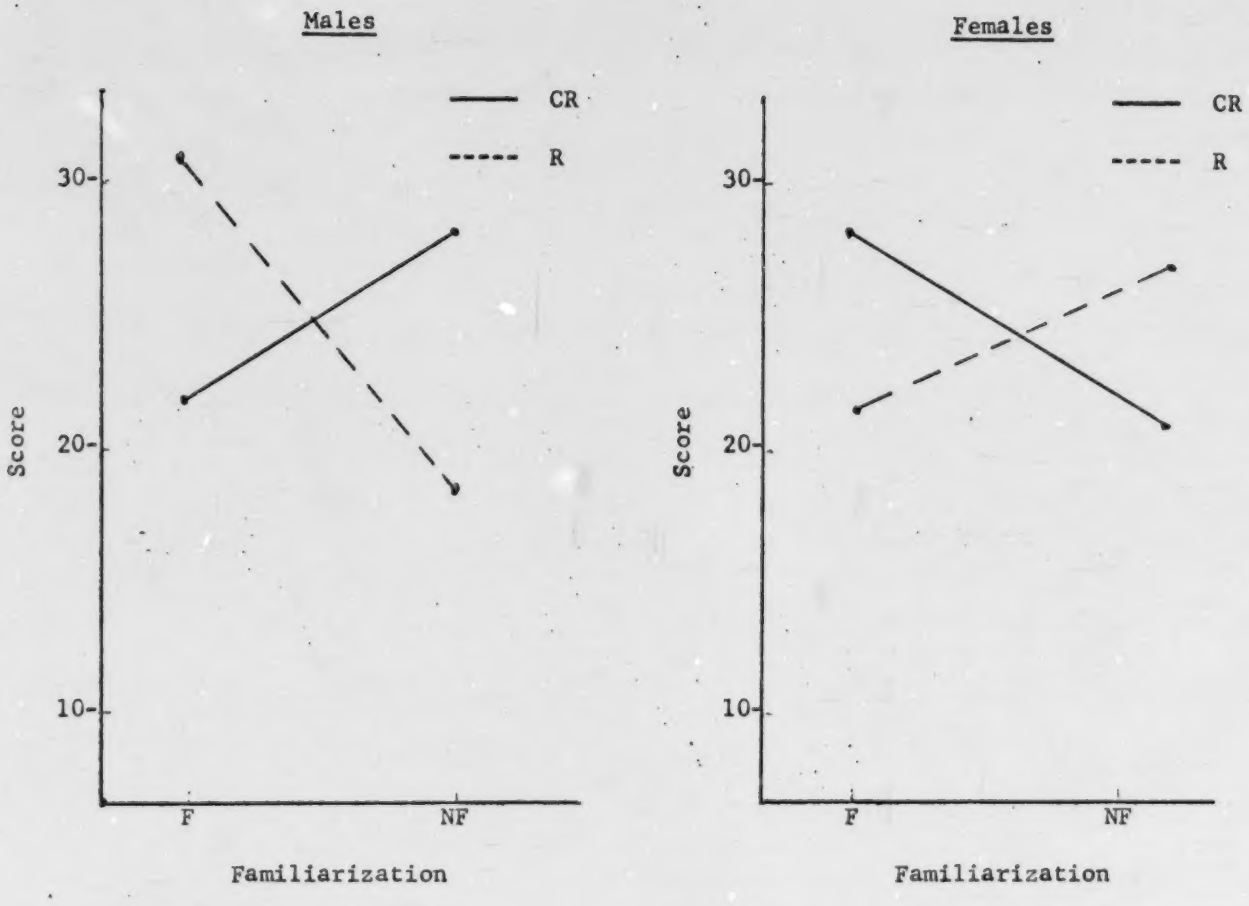

Fig. 3. Mean scores attained on the verbal portion of the delayed post-test for male and female Ss.